Raytheon

R29600 Series Standard PROMs and Power-Switched SPROMs

Features/Benefits
■ All devices are available in both commercial (0°C to +75°C) and military (-55°C to +125°C) temperature range
■ All standard PROMs are offered in power-switched SPROM versions
■ Radiation tolerant
■ Typically, 75% power savings achieved on deselected SPROMs
■ Device pinouts comply with JEDEC standards
■ All devices programmed on standard PROM programmers
■ Reliable nichrome fuses
■ Three-state outputs
■ Available in surface mount and through-hole packaging

Applications
■ Microprogram control store
■ Microprocessor program store
■ Programmable logic
■ Custom look-up tables
■ Security encoding/decoding
■ Code converter
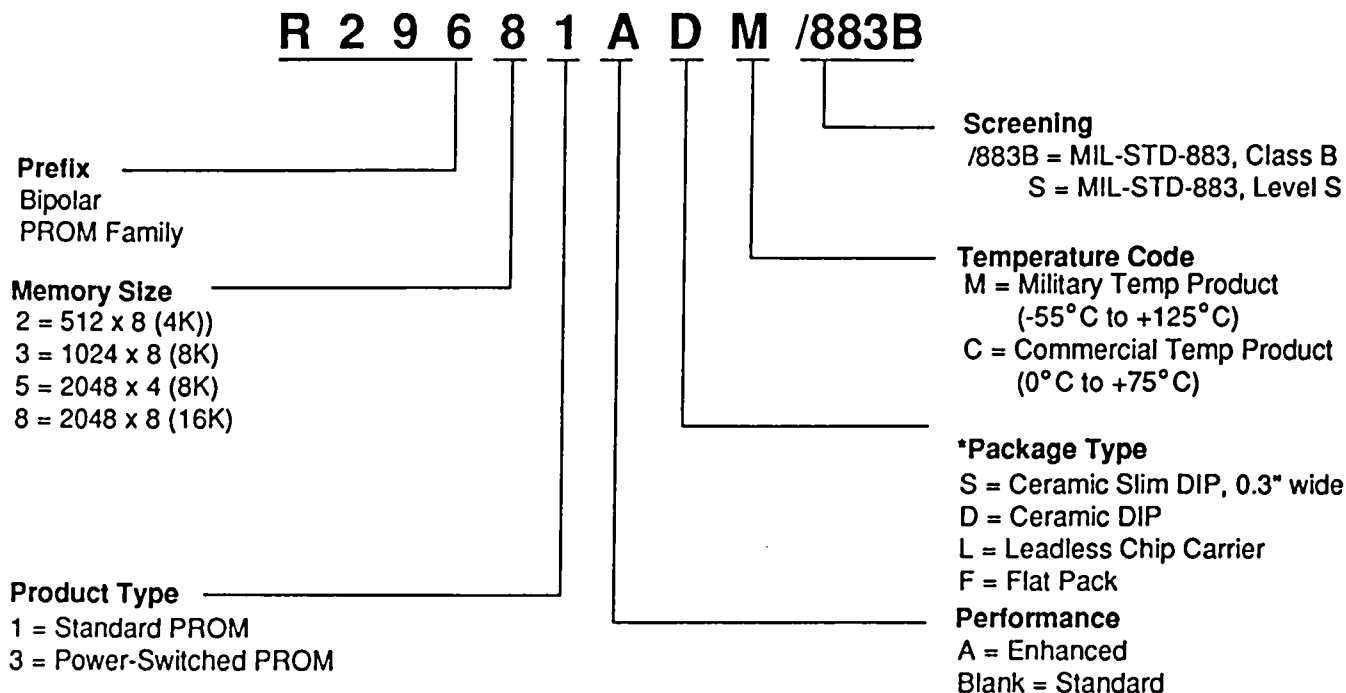■ Character generator
■ Use in redundant systems

Description
Raytheon's R29600 Series of Bipolar Field Programmable Read-Only Memories include both standard and power-switched versions. Chip select inputs provide logic flexibility and ease of memory expansion decoding.

All Raytheon R29600 Series PROMs and SPROMs are manufactured with nichrome fuses and low power Schottky technology. The devices are shipped with all bits in the HIGH (logical ONE) state. To achieve a LOW state in a given bit location the nichrome link is fused open by passing a short, high current pulse through the link. All R29600 Series devices are programmed using the same programming technique.

Standard PROMs are enabled when $\overline{CS}$ is low and CS is high. Power-switched SPROMs are enabled when $\overline{PS}$ is low and PS is high. See individual data sheets for device enabling schemes.

Standard Product Ordering Information

R 2 9 6 8 1 A D M /883B

Screening
/883B = MIL-STD-883, Class B
S = MIL-STD-883, Level S

Prefix
Bipolar
PROM Family

Temperature Code
M = Military Temp Product
(-55°C to +125°C)
C = Commercial Temp Product
(0°C to +75°C)

Memory Size
2 = 512 x 8 (4K))
3 = 1024 x 8 (8K)
5 = 2048 x 4 (8K)
8 = 2048 x 8 (16K)

*Package Type
S = Ceramic Slim DIP, 0.3" wide
D = Ceramic DIP
L = Leadless Chip Carrier
F = Flat Pack

Product Type
1 = Standard PROM
3 = Power-Switched PROM

Performance
A = Enhanced
Blank = Standard

Country of Origin Designator - Prefixes Date Code
O = U.S.A

65-4058

JAN Ordering Information

MII-M-38510 Slash Sheet Part Number	Raytheon Part Number
Mil-M-38510/20902BVA	JR29651DQ (2K x 4, 18-pin ceramic DIP)
Mil-M-38510/20904BJA	JR29631DR (1K x 8, 24-pin ceramic DIP)
Mil-M-38510/21002BJA	JR29681DR (2K x 8, 24-pin ceramic DIP)

Raytheon Semiconductor CAGE Code Number — 07933

Raytheon

Absolute Maximum Ratings (above which the useful life may be impaired)

Supply Voltage to Ground Potential (continuous), V_{CC} .... -0.5V to +7.0V
DC Input Current... -30 mA to +5.0 mA
DC Input Voltage (address inputs)... -0.5V to +5.5V
DC Input Voltage (chip/power select input pin) .... -0.5V to +33V
DC Voltage Applied to Outputs (except during programming)............................ -0.5V to +V_{CC} max.
Output Current into Outputs During Programming ....240 mA
DC Voltage Applied to Outputs During Programming 26V
Junction Temperature ....+175°C
Storage Temperature ....-65°C to +150°C
Programming Temperature ....25 ±5°C
Current Density (metallization)..< 5 x 10⁵A/cm²
Lead Temperature (soldering, 10 seconds) ....300°C
Thermal Resistance, Junction-to-Case $θ_{JC}$
    Dual-In-Line ....≤ 11°C/W
    Leadless Chip Carrier ....≤ 10°C/W

Operating Conditions

| Parameter | Description | Commercial | | Military | | Unit |
		Min.	Max.	Min.	Max.	
V_{CC}	Supply Voltage	4.75	5.25	4.5	5.5	V
T_C	Case Operating Temperature			-55	+125	°C
T_A	Ambient Operating Temperature	0	+75			°C
V_{IL}*	DC/Functional Low Level Input Voltage		0.8		0.8	V
V_{IH}*	DC/Functional High Level Input Voltage	2.0		2.0		V
V_{IL}	AC Low Level Input Voltage		0		0	V
V_{IH}	AC High Level Input Voltage	3.0		3.0		V

*Functional tests shall be conducted at input test conditions as follows: V_{IH} = V_{IH}(min) +20%, -0%; V_{IL} = V_{IL}(max) +0%, -50%. Devices may be tested using any input voltage within this input voltage range but shall be guaranteed to V_{IH}(min) and V_{IL}(max). CAUTION: To avoid test correlation problems, the test system noise (e.g., testers, handlers, etc.) should be verified to assure that V_{IH}(min) and V_{IL}(max) requirements are not violated at the device terminals.

Electrical Characteristics
Over Operating Range
Military devices conform to Mil-Std-883, Group A, Subgroups 1, 2 and 3

Parameter	Description	Test Conditions		Min	Max	Units
V_{OH}	Output High Voltage	V_{CC} = Min, I_{OH} = -2 mA $V_{IN} = V_{IH}$ or V_{IL}		2.4		V
V_{OL}[1]	Output Low Voltage	V_{CC} = Min	I_{OL} = 8 mA		0.4	V
		$V_{IN} = V_{IH}$ or V_{IL}	I_{OL} = 16 mA		0.5	
I_{IL}	Input Low Current	V_{CC} = Max, V_{IN} = 0.4V			-250	μA
I_{IH}	Input High Current	V_{CC} = Max, V_{IN} = 2.7V			10	μA
		V_{CC} = Max, V_{IN} = 5.5V			40	
I_{OS}[2][3]	Output Short Circuit Current	V_{CC} = Max, V_{OUT} = 0.0V		-15	-85	mA
V_{IC}	Input Clamp Voltage	V_{CC} = Min, I_{IN} = -18 mA		-1.2	V	
I_{CEX}	Output Leakage Current	V_{CC} = Max Chip Disabled	V_{OUT} = 5.5V V_{OUT} = 0.4V		+40 -40	μA

Notes

1. This characteristic cannot be tested prior to programming; it is guaranteed by factory testing.
2. Not more than one output should be shorted at a time. Duration of the short circuit should not exceed 1 second.
3. V_{OUT} = 0.2V for military temperature range product.

Pin Names

| Symbol	Description
A^O - A^N	Address Inputs
$\overline{CS}$	Chip Select Active Low (PROM)
CS	Chip Select Active High (PROM)
$\overline{PS}$	Power Select Active Low (SPROM)
PS	Power Select Active High (SPROM)
O^I - O^N	Data Outputs

Raytheon
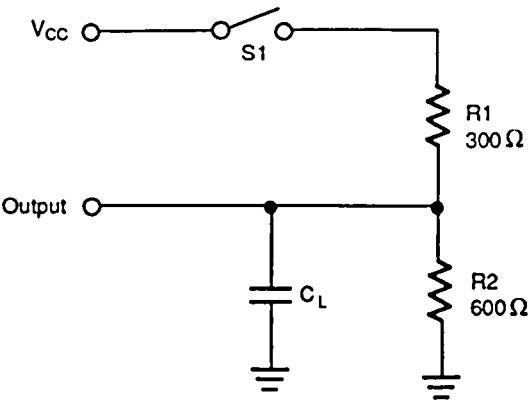
65-4059

Notes:
1. t_{AA} is tested with switch S_1 closed and $C_L = 30$ pF.

2. t_{EA} is tested with $C_L = 30$ pF; S_1 is open for high impedance to "1" test and closed for high impedance to "0" test.

3. t_{ER} is tested with $C_L = 5$ pF; S_1 is open for "1" to high impedance test and measured at V_{OH} -0.5V output level and is closed for "0" to high impedance test and measured at V_{OL} +0.5V output level.

Figure 1. AC Test Load Circuit
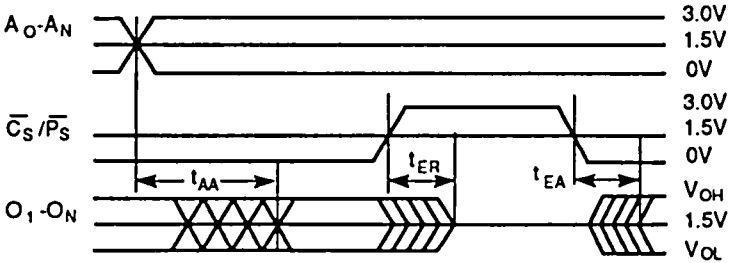
65-4060

Keys to Timing Diagram

Waveforms	Inputs	Outputs
———	Must be Steady	Will be Steady
XXXX	Don't Care. Any Change Permitted	Changing State Unknown
〉〉–〈〈	Does Not Apply	Center Line is High Impedance Off State

Figure 2. Switching Waveforms

Raytheon

512 x 8 PROM — R29621/R29621A
Power and AC Characteristics Over Operating Range
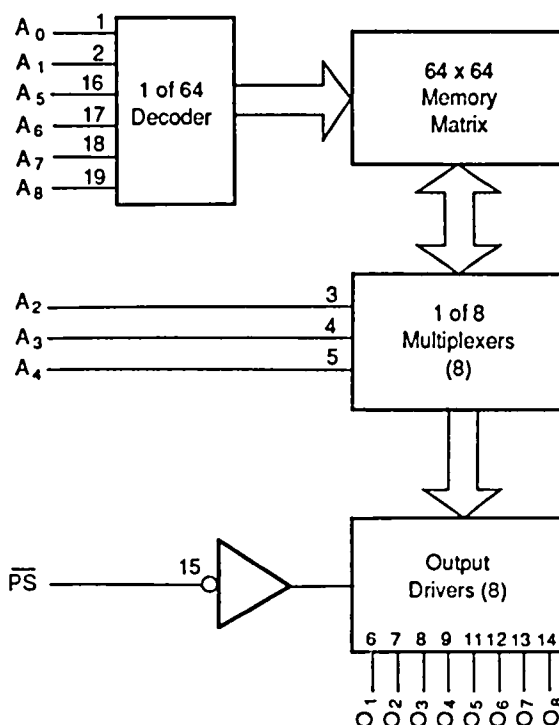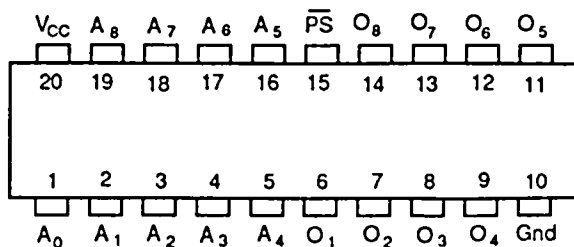Military ICC conforms to Mil-Std-883, Group A, Subgroups 1, 2 and 3
Military AC parameters conform to Mil-Std-883, Group A, Subgroups 9, 10 and 11

Param-eter	Description	Test Conditions	Maximum Limits				Units
			R29621AC	R29621C	R29621AM	R29621M	
I_{cc}	Power Supply Current	V_{cc} = Max All Inputs GND	155	155	155	155	mA
t_{AA}	Address Access Time	C_L = 30 pF *	50	65	60	80	ns
t_{EA}	Enable Access Time	R1 = 300Ω to V_{cc}	30	30	40	40	ns
t_{ER}	Enable Recovery Time	R2 = 600Ω to GND	30	30	40	40	ns
P_D	Power Dissipation	16 mA Load	814	814	853	853	mW

*See AC Test Load Circuit and Switching Waveforms

Conforms to MIL-STD-1835

Raytheon Package Designator	Description Package Type Designator	Case Outline Letter Figure No. Configuration No.	Dimensions Reference Letter
D	GDIP1-T20	R, 12, A	D-8

Pin-Out Information

Dual In-Line Package

Pin 15 is also the programming pin (pp)

65-1314

Block Diagram

65-0112

Raytheon

512 x 8 SPROM — R29623/R29623A
Power and AC Characteristics Over Operating Range

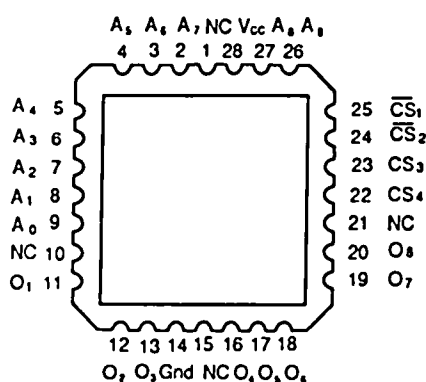Military ICC conforms to Mil-Std-883, Group A, Subgroups 1, 2 and 3
Military AC parameters conform to Mil-Std-883, Group A, Subgroups 9, 10 and 11

Param-eter	Description	Test Conditions	Maximum Limits				Units
			R29623AC	R29623C	R29623AM	R29623M	
I_{CCD}	Power Down, Supply Current (disabled)	V_{CC} = Max $\overline{PS}$ = V_{IH}, All other inputs = GND	45	45	45	45	mA
I_{CC}	Supply Current (enabled)	V_{CC} = Max All inputs = Gnd	155	155	155	155	mA
t_{AA}	Address Access Time	C_L = 30 pF *	50	70	60	85	ns
t_{EA}	Enable Access Time	R1 = 300Ω to V_{CC}	55	70	65	85	ns
t_{ER}	Enable Recovery Time	R2 = 600Ω to GND	30	30	40	40	ns
P_D	Power Dissipation (Disabled)	16 mA Load	236	236	248	248	mW
P_D	Power Dissipation (Enabled)		814	814	853	853	mW

*See AC Test Load Circuit and Switching Waveforms

Conforms to MIL-STD-1835

Raytheon Package Designator	Description Package Type Designator	Case Outline Letter Figure No. Configuration No.	Dimensions Reference Letter
D	GDIP1-T20	R, 12, A	D-8

Block Diagram

Pin Out Information

Dual In-Line Package

Pin 15 is also the programming pin (pp)   65-1316

65-0113

Raytheon

1024 x 8 PROM — R29631/R29631A
Power and AC Characteristics Over Operating Range

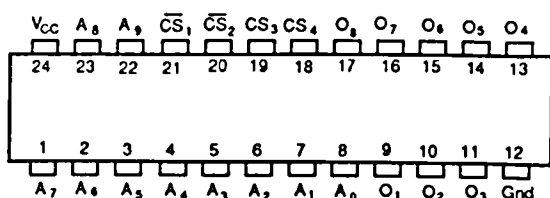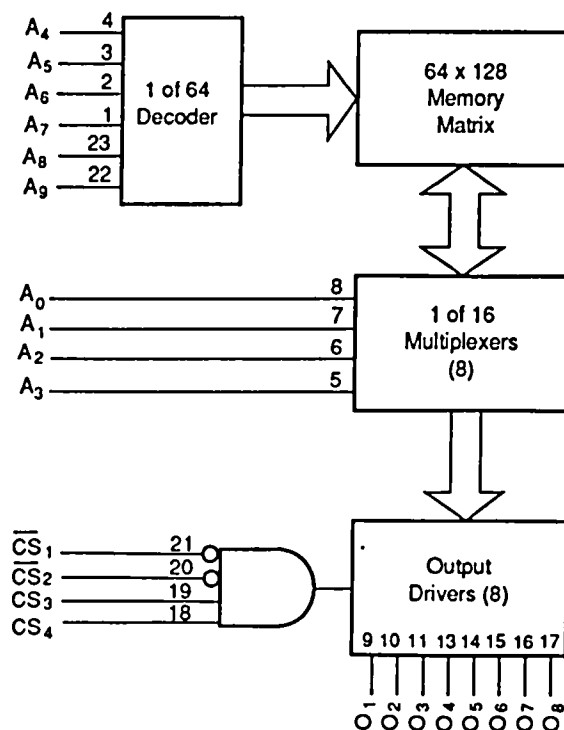Military ICC conforms to Mil-Std-883, Group A, Subgroups 1, 2 and 3
Military AC parameters conform to Mil-Std-883, Group A, Subgroups 9, 10 and 11

Param-eter	Description	Test Conditions	Maximum Limits				Units
			R29631AC	R29631C	R29631AM	R29631M	
I_{CC}	Power Supply Current	V_{CC} = Max All inputs = Gnd	170	170	170	170	mA
t_{AA}	Address Access Time	C_L = 30 pF *	50	70	60	90	ns
t_{EA}	Enable Access Time	R1 = 300Ω to V_{CC}	30	35	40	40	ns
t_{ER}	Enable Recovery Time	R2 = 600Ω to GND	30	30	40	40	ns
P_D	Power Dissipation	16 mA Load	893	893	935	935	mW

*See AC Test Load Circuit and Switching Waveforms

Conforms to MIL-STD-1835

Raytheon Package Designator	Description Package Type Designator	Case Outline Letter Figure No. Configuration No.	Dimensions Reference Letter
D	GDIP1-T24	J, 12, A	D-3
L	CQCC1-N28	3, 15	C-4
F	GDFP1-F24	11, A	F-16

Pin Out Information

Leadless Chip Carrier (28-Terminal)

Pin 24 is also the programming pin (pp)

Dual-In-Line Package

Pin 20 is also the programming pin (pp)   65-4069

Block Diagram

65-0116

Raytheon

1024 x 8 SPROM — R29633/R29633A
Power and AC Characteristics Over Operating Range
Military ICC conforms to Mil-Std-883, Group A, Subgroups 1, 2 and 3
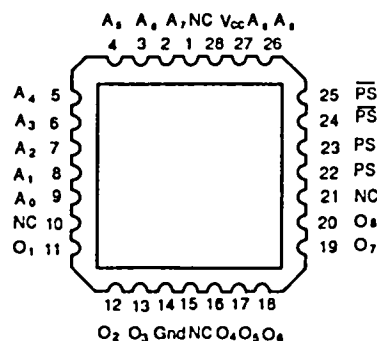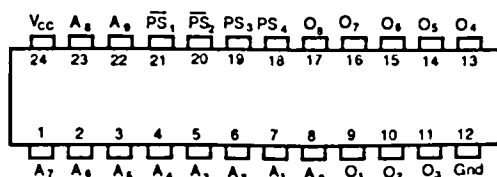Military AC parameters conform to Mil-Std-883, Group A, Subgroups 9, 10 and 11

Param-eter	Description	Test Conditions	Maximum Limits				Units
			R29633AC	R29633C	R29633AM	R29633M	
I_{CCD}	Power Down, Supply Current (Disabled)	V_{CC} = Max PS = V_{IH}, All other	45	45	45	45	mA
ICC	Supply Current (Enabled)	Inputs = GND VCC = Max All inputs = GND	170	170	170	170	mA
tAA	Address Access Time	CL = 30 pF*	50	70	70	90	ns
tEA	Enable Access Time	R1 - 300Ω to VCC	50	75	70	115	ns
tER	Enable Recovery Time	R2 - 600Ω to GND	30	30	40	40	ns
PD	Power Dissipation (Disabled)	16 mA Load	236	236	248	248	mW
PD	Power Dissipation Enabled		893	893	935	935	mW

Conforms to MIL-STD-1835

Raytheon Package Designator	Description Package Type Designator	Case Outline Letter Figure No. Configuration No.	Dimensions Reference Letter
D	GDIP1-T24	J, 12, A	D-3
L	CQCC1-N28	3, 15	C-4
F	GDFP1-F24	11, A	F-16

Pin Out Information
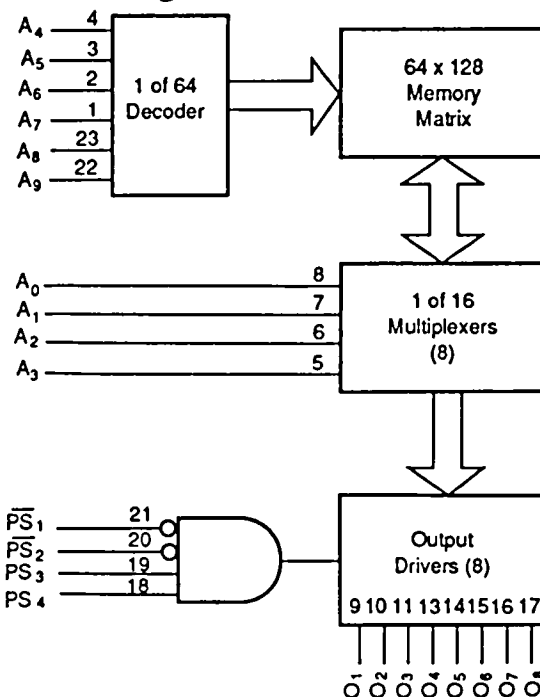### Leadless Chip Carrier (28-Terminal)

Pin 24 is also the programming pin (pp)

Dual In-Line Package

Pin 20 is also the programming pin (pp)   65-4071

Block Diagram

65-0117

2048 x 4 SPROM — R29653/R29653A
Power and AC Characteristics Over Operating Range
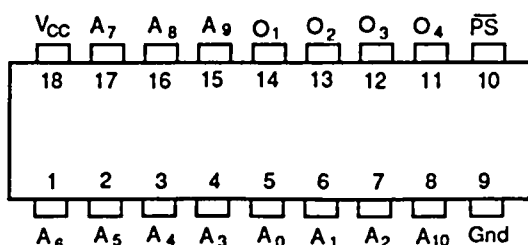Military ICC conforms to Mil-Std-883, Group A, Subgroups 1, 2 and 3
Military AC parameters conform to Mil-Std-883, Group A, Subgroups 9, 10 and 11

Param-eter	Description	Test Conditions	Maximum Limits				Units
			R29653AC	R29653C	R29653AM	R29653M	
I_{CCD}	Power Down, Supply Current (disabled)	V_{CC} = Max PS = V_{IH}, All other inputs = GND	45	45	45	45	mA
I_{CC}	Supply Current (enabled)	V_{CC} = Max All inputs = Gnd	170	170	170	170	mA
t_{AA}	Address Access Time	C_L = 30 pF *	65	75	75	90	ns
t_{EA}	Enable Access Time	R1 = 300Ω to V_{CC}	70	80	80	95	ns
t_{ER}	Enable Recovery Time	R2 = 600Ω to GND	35	35	45	45	ns
P_D	Power Dissipation (Disabled)	16 mA Load	236	236	248	248	mW
P_D	Power Dissipation (Enabled)		893	893	935	935	mW

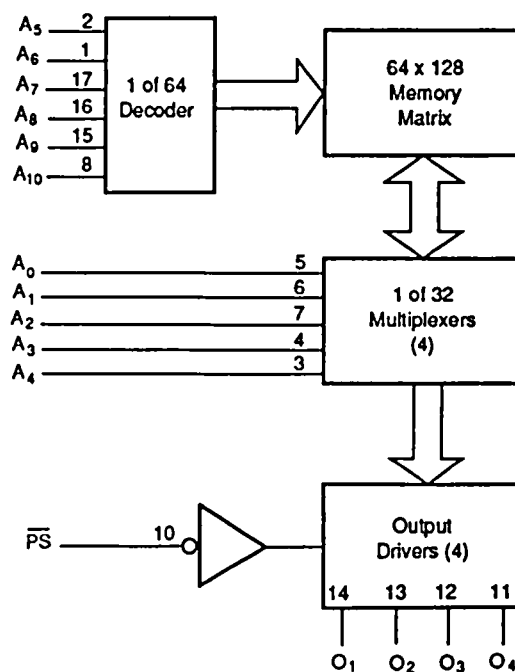*See AC Test Load Circuit and Switching Waveforms

Conforms to MIL-STD-1835

Raytheon Package Designator	Description Package Type Designator	Case Outline Letter Figure No. Configuration No.	Dimensions Reference Letter
D	GDIP1-T18	V, 12, A	D-6

Pin Out Information

Dual In-Line Package

Pin 10 is also the programming pin (pp)

65-1326

Block Diagram

65-0123

2048 x 8 PROM — R29681/R29681A
Power and AC Characteristics Over Operating Range
Military ICC conforms to Mil-Std-883, Group A, Subgroups 1, 2 and 3
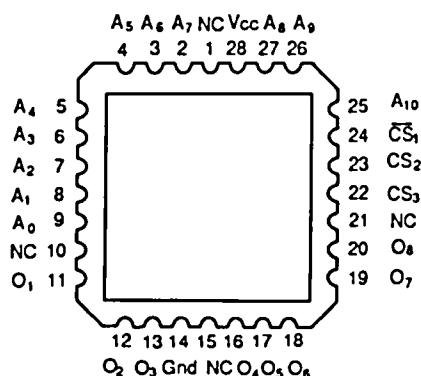Military AC parameters conform to Mil-Std-883, Group A, Subgroups 9, 10 and 11

Param- eter	Description	Test Conditions	Maximum Limits				Units
			R29681AC	R29681C	R29681AM	R29681M	
I_{cc}	Power Supply Current	V_{cc} = Max All inputs = Gnd	180	180	180	180	mA
t_{AA}	Address Access Time	C_L = 30 pF *	50	80	70	100	ns
t_{EA}	Enable Access Time	R1 = 300Ω to V_{cc}	35	40	45	50	ns
t_{ER}	Enable Recovery Time	R2 = 600Ω to GND	30	40	35	45	ns
P_D	Power Dissipation	16 mA Load	945	945	990	990	mW

*See AC Test Load Circuit and Switching Waveforms

Conforms to MIL-STD-1835

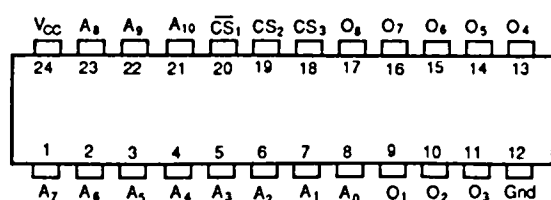| Raytheon Package Designator	Description Package Type Designator	Case Outline Letter Figure No. Configuration No.	Dimensions Reference Letter
S	CDIP4-T24	L, 12, C	D-9
D	GDIP1-T24	J, 12, A	D-3
L	CQCC1-N28	3, 15	C-4

Contact factory for flat pack package.

Pin Out Information

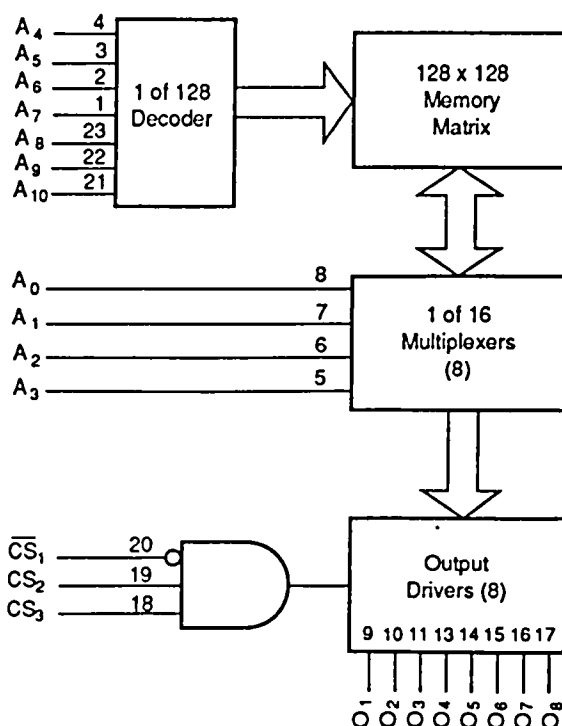### Leadless Chip Carrier (28-Terminal)

Pin 24 is also the programming pin (pp)

Dual-In-Line Package
Available in 0.3" and 0.6" Wide Packages

Pin 20 is also the programming pin (pp)

65-4073

Block Diagram

65-0128

Raytheon

2048 x 8 SPROM — R29683/R29683A
Power and AC Characteristics Over Operating Range
Military ICC conforms to Mil-Std-883, Group A, Subgroups 1, 2 and 3
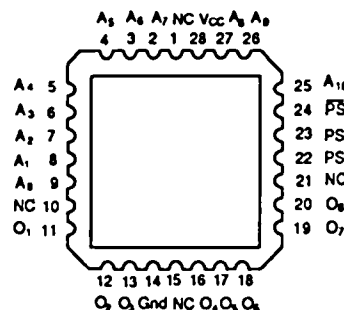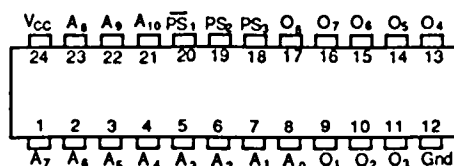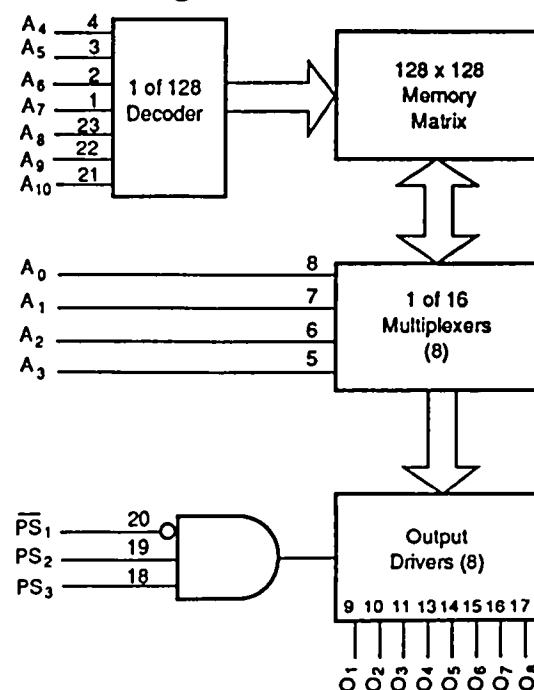Military AC parameters conform to Mil-Std-883, Group A, Subgroups 9, 10 and 11

Param-eter	Description	Test Conditions	Maximum Limits				Units
			R29683AC	R29683C	R29683AM	R29683M	
I_{CCD}	Power Down, Supply Current (disabled)	V_{CC} = Max $\overline{PS}$ = V_{IH}, All other inputs = GND	50	50	50	50	mA
I_{CC}	Supply Current (enabled)	V_{CC} = Max All inputs = Gnd	180	180	180	180	mA
t_{AA}	Address Access Time	C_L = 30 pF *	50	85	70	105	ns
t_{EA}	Enable Access Time	R1 = 300Ω to V_{CC}	65	85	85	105	ns
t_{ER}	Enable Recovery Time	R2 = 600Ω to GND	35	45	45	50	ns
P_D	Power Dissipation (Disabled)	16 mA Load	263	263	275	275	mW
P_D	Power Dissipation (Enabled)		945	945	990	990	mW

*See AC Test Load Circuit and Switching Waveforms

Conforms to MIL-STD-1835

Raytheon Package Designator	Description Package Type Designator	Case Outline Letter Figure No. Configuration No.	Dimensions Reference Letter
S	CDIP4-T24	L, 12, C	D-9
D	GDIP1-T24	J, 12, A	D-3
L	CQCC1-N28	3, 15	C-4

Contact factory for flat pack package.

Pin Out Information

Leadless Chip Carrier (28-Terminal)

Pin 24 is also the programming pin (pp)

Dual-In-Line Package
Available in 0.3" and 0.6" Wide Packages

Pin 20 is also the programming pin (pp)

65-4074

Block Diagram

65-0129

Dynamic Life Test/Burn-In Circuits

In accordance with Mil-Std-883, Methods 1005/1015, Condition D

$T_A = 125 {}^{+10}_{-0}$ °C minimum
$V_{CC} = 5.25 \pm 0.25V$

Square Wave Pulses on A^0 to A^n are:
  50% ±10% duty cycle
  Frequency of each address is to be
    1/2 of each preceding input,
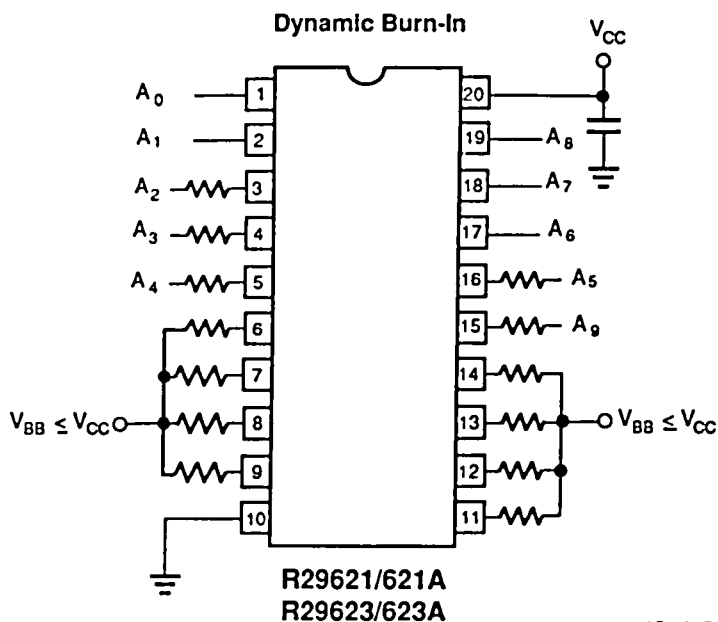   with A^0 beginning at 100 kHz
    (e.g., A^0 = 100 kHz ±10%,
    A^1 = 50 kHz ±10%,
    A^2 = 25 kHz ±10%,

    A^n = 1/2 A^{n-1} ±10%, etc.)
Resistors are optional on input pins
(R = 300Ω ±10%)

Dynamic Burn-In

R29621/621A
R29623/623A

65-4065

Dynamic Burn-In

R29631/631A
R29633/633A
R29681/681A
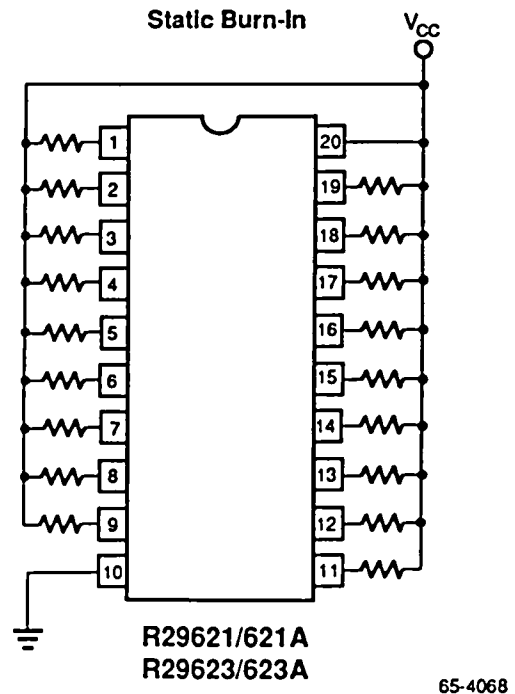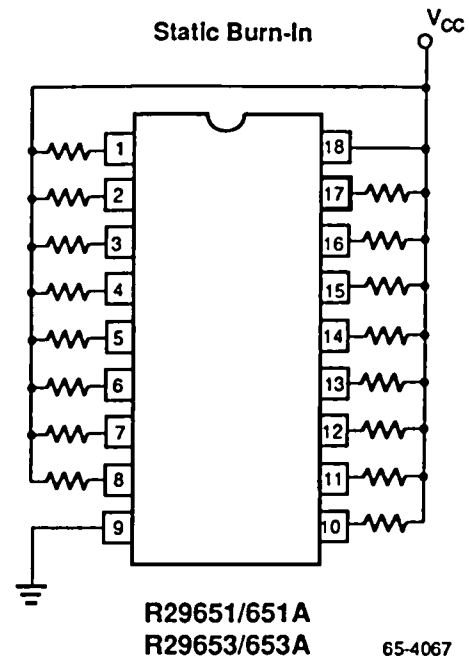R29683/683A

65-4063

Dynamic Burn-In

R29651/651A
R29653/653A
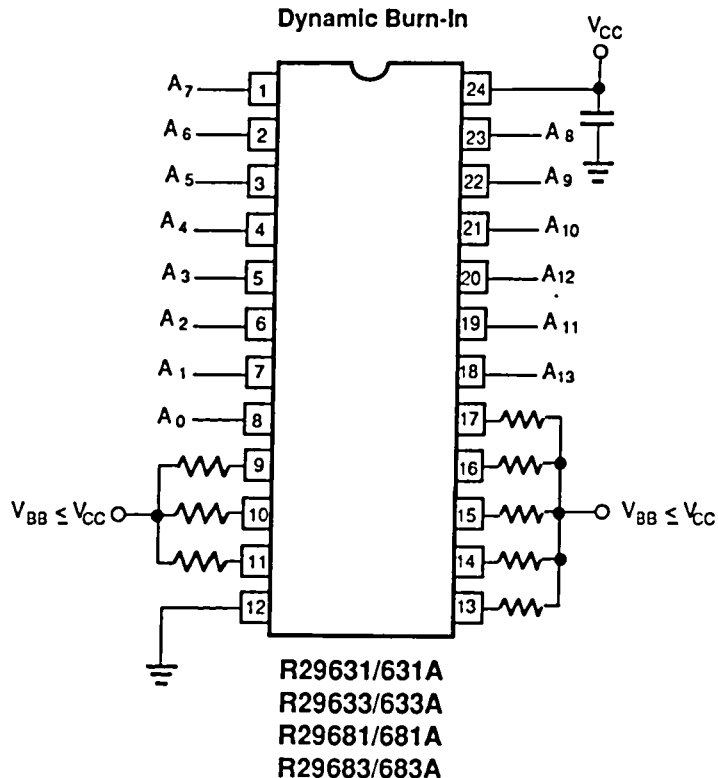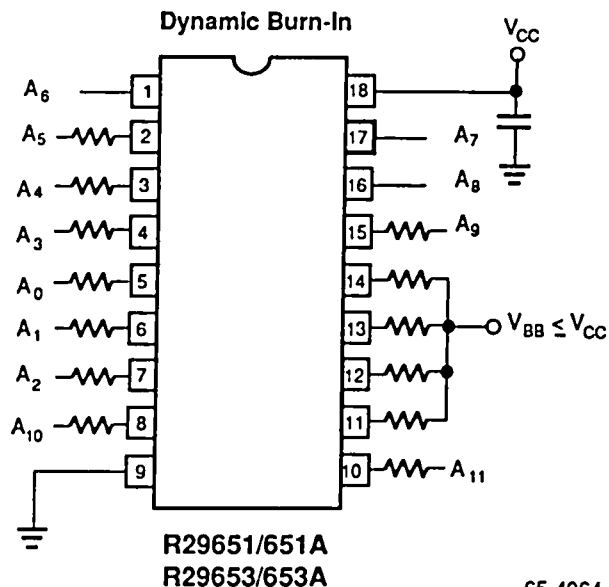
65-4064

Static Life Test/Burn-In Circuits

In accordance with Mil-Std-883, Methods 1005/
1015, Condition C

$T_A = 125 ^{+10}_{-0}$ °C minimum
$V_{CC} = 5.25V \pm 0.25V$

Resistors are optional on input pins
$(R = 300\Omega \pm 10\%)$

Static Burn-In V_{CC}

R29651/651A
R29653/653A   65-4067

Static Burn-In V_{CC}

R29631/631A
R29633/633A
R29681/681A
R29683/683A   65-4066

Static Burn-In V_{CC}

R29621/621A
R29623/623A   65-4068

Raytheon   15
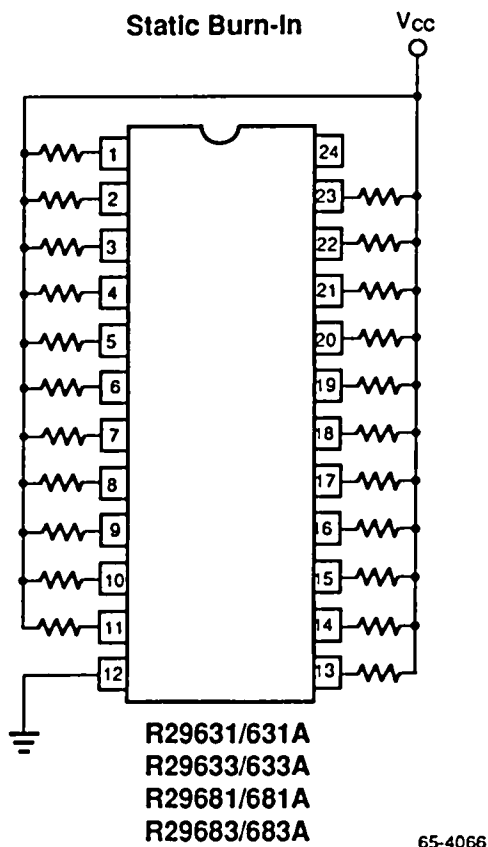
Programming Parameters (Do not test these limits or you may program the device)

Param-eter	Description	Test Conditions (T_A = 25°C)	Min	Recom-mended	Max	Units
V_{CCP}	V_{CC} required during programming		5.4	5.5	5.6	V
T_R	Rise time of program pulse applied to the data out or program pin		0.34	0.4	1.25	V/µS
T_{PP}	Programming pulse width		80	95	110	µS
T_P	Required coincidence among the program pin, output, address and V_{CC} for programming		1.0		40	µS
T_{D1}	Required time delay between disabling the memory output and application of the output programming pulse	Measure at 10% levels	70	80	90	µS
T_{D2}	Required time delay between removal of programming pulse and enabling the memory output	Measure at 10% levels	100			ns
V_{PP}	Required programming voltage on program pin		27	33	33	V
V_{OUT}	Required programming voltage on output pin		20	26	26	V
I_{OLV1}	Output current required during verification	Chip enabled V_{CC} = 4.2V	11	12	13	mA
I_{OLV2}	Output current required during verification	Chip enabled V_{CC} = 6V	0.1	0.2	0.3	mA
I_L	Required current limit of the power supply feeding the program pin and the output during programming	V_{PP} = 33V V_{OUT} = 26V V_{CC} = 5.5V	240			mA
MDC	Maximum duty cycle during automatic programming of program pin	$\dfrac{T_{PP}}{T}$			50	%

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T_R = 0.34V/µS Min. — 1.25V/µS Max.
T_{PP} = 80 µS Min. — 110 µS Max.
T_P = 1 µS Min. — 40 µS Max.
T_{D1} = 70 µS Min. — 90 µS Max.
T_{D2} = 100 nS Min.
V_{PP} = 27V Min. — 33V Max.
V_{OUT} = 20V Min. — 26V Max.
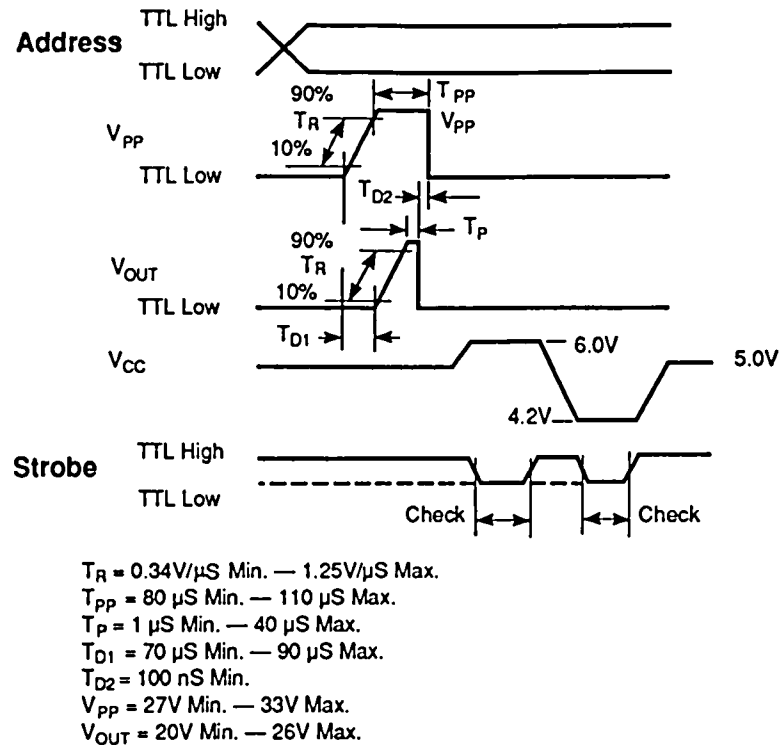
Note: Output Load = 0.2 mA During 6.0V Check
Output Load = 12 mA During 4.2V Check

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Figure 3. Programming Timing

Device Programming Inputs

If you would like to have Raytheon program your devices, please submit one of the following:
• Two masters and truth table
• Two masters and checksum

In either case, we require customer approval prior to programming the devices.

Please do not hesitate to contact Raytheon for samples, if you need blank devices to program as masters.

Commercial Programmers (subject to change)

Equipment must be calibrated at regular intervals. Each time a new board or a new programming module is inserted, the whole system should be checked. Both timing and voltages must meet published specifications for the device.

Please contact the following manufacturers for equipment information:

Data I/O Corp.
10525 Willows Road, N.E.
P.O. Box 97046
Redmond, WA 98073-9746
(800) 247-5700

Stag Microsystems Inc.
1600 Wyatt Drive, Suite 3
Santa Clara, CA 95054
(408) 988-1118

Commercial Surface Mount Socket Adapter Manufacturer (subject to change)

Please contact the following manufacturer for equipment information:

Emulation Technology, Inc.
2344 Walsh Avenue, Bldg. F
Santa Clara, CA 95051
(408) 982-0660

The companies listed above are not intended to be a complete guide of manufacturers of programmers or adapters, nor does Raytheon endorse any specific company.

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Revisions

Rev. No.	Date	Description
A	12/88	Complete update R29671M: Changed t_{AA} from 100 ns to 95 ns max. R29671AM: Changed t_{AA} from 80 ns to 70 ns max. R29671AC: Changed t_{ER} from 40 ns to 35 ns max. R29631AC: Changed t_{EA} from 35 ns to 30 ns max. R29631C: Changed t_{EA} from 30 ns to 35 ns max. I_{IH}: Changed from 0.1 mA to 40 µA max. V_{IC}: Changed from -1.5V to -1.2V max. I_{CEX}: Changed from ±100 µA to ±40 µA max. Changed commercial temperature range from 75°C max. to 70°C max. I_L (programming parameter): Changed from 250 mA to 240 mA min. Removed R29613/R29613A data sheet.
B	4/92	Removed R29671/R29671A/R29673 Removed SMD information Added flat pack information to R29631/R29631A/R29633/R29633A specifications Added resistor value to dynamic and static burn-in circuits Removed programming instructions Changed programming rise time (T_R) from 0.46 V/µs max. to 1.25 V/µs max. Changed programmer and adapter manufacturer information Changed VO condition for IOS (commercial temperature range) from 0.2V to 0.0V Changed IOS minimum limit from -12 mA to -15 mA

Raytheon Regional Sales Offices

CALIFORNIA
Raytheon Semiconductor
10A Goodyear
Irvine, CA 92718
(714) 830-2808
FAX: 714-830-2607

FLORIDA
Raytheon Semiconductor
393 Whooping Loop, Suite 1427
Altamonte Springs, FL 32701
(407) 339-4820
FAX: 407-339-4829

ILLINOIS
Raytheon Semiconductor
1430 Branding Lane
Downers Grove, IL 60515
(708) 810-1577
FAX: (708) 810-1683

MASSACHUSETTS
Raytheon Semiconductor
100 Hayden Avenue
Lexington, MA 02173
(617) 860-4010
Telex: 374-8415
FAX: 617-640-4020

NEW YORK
Raytheon Semiconductor
1440 Veterans Highway
Hauppauge, NY 11788-4896
(516) 582-3646
TWX: 310-376-7027
FAX: 516-582-3341

Raytheon International Sales Offices

GERMANY
Raytheon Halbleiter GmbH
Thalkirchner Strasse 74
D-8000 Munchen 2
West Germany
Telephone: 49 89 / 53 09 93-0
FAX: 49 89 / 53 14 39

UNITED KINGDOM
Raytheon Semiconductor
Pelican House
83 New Street
Andover, Hants. SP10 1DR
United Kingdom
Telephone: 44 264-334616
FAX: 44 2643-34620

JAPAN
Raytheon Semiconductor
International Company
Matsukaze Building 5/F
4-1-1 Kitashingawa Sinagawa-Ku
Tokyo 140 Japan
Telephone: 81-33-280-4776
FAX: 81-33-280-4156

FRANCE
Raytheon Semiconductor
France
LaBoursidiere, RN 186
F-92350 Plessis Robinson
Cedex, France
Telephone: 33-1-46310676
FAX: 33-1-46324608

Raytheon Company
Semiconductor Division

350 Ellis Street
Mountain View CA 94039-7016
415 968 9211
TWX 910 379 6484

Raytheon